A 1927 Hartley Oscillator

Part 1. The AWA 1929 QSO Party

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In 1971, the Antique Wireless Association (AWA) initiated the Old Timer's Contest in which members work each other using pre-1941 transmitters and receivers. This contest uses the bands from 160 to 20M. Normally held in early spring or late winter, this contest was so popular that the AWA decided to introduce another contest to be held in the fall or early winter. This new contest, known as the 1929 QSO Party has the following rules:

1. The transmitter must be a self-excited oscillator. No MOPA or crystal.
2. Power input may not exceed 10 watts except that from midnight to 8 AM, 20 watts is permitted.
3. Any antenna system may used.
4. Frequencies: 3580-3600 kHz.
5. Exchange: RST and power input.

It is suggested that a straight key be used. It also adds to the fun if you use a regenerative receiver or other vintage receiver.

It is not necessary that your transmitter be one actually built before 1930. An article in the AWA's *Old Timer's Bulletin* (OTB) in December 1987 stated that it is perfectly acceptable to build a replica transmitter using new parts just as long as you use old-time circuits and tubes that were available during that era. This opens the door so that anyone who wishes to join the fun can now do so. Naturally, for maximum enjoyment, you will want to use as many genuine old-time parts as you can find.

The efficiency of most low-power self-excited oscillators will usually range from 25 to 50 percent so your power output will typically run form 2.5 to 5 watts. Now some of you are going to wonder if its possible to work anyone if you are limited to such low power. The contest results listed each year in the OTB clearly show that low power is only a minor factor - skill and patience are much more important. The 1929 QSO Party often attracts up to 40 or 50 entrants and many operators succeed in working the majority of those stations. Table I shows that even stations running much less than the maximum authorized power can do quite well. Of course, many of these fellows are well known crackerjack operators. But they need to work you so they will always slow down to your speed. In fact, most QSOs in this contest seem to be rather laid back and friendly - reminiscent of the early years of ham radio which, after all, is the whole idea of this QSO party. I have met many of these operators at the AWA's annual Fall Conference and they are without exception extraordinary people whose friendship I treasure. All of us look forward to this event like kids waiting for Christmas.

Typical Old-Time Circuits

Most contestants favor the Hartley oscillator, see Figure 1-A. A well-built Hartley is normally very stable and gives a good T9 note. For best results, a high-C tank is necessary. This results in a large circulating tank current so the tank coil is usually made from 1/4" copper tubing and is supported on a pair of horizontal glass towel bars or on beehive insulators. The Hartley is easy to adjust for proper excitation and loading but it does have one problem. As usually constructed, the rotor of the tuning condenser is not at ground RF potential so there is a hand-capacity detuning effect.

YEAR	STATION	TUBE &/OR CKT USED	INPUT WATTS	# QSOs
1983	W2AN	112A	4	8
1984	W4COC	10, TNT	6	11
1985	W2BJI	UV-202	7.5	20
1986	W2FFU	CX-301A	1.5	8
1987	W1DX	45	6	17
1988	WB2MVK	210	6	22
1989	K2LP	210	7	23
1990	W3BYM	45	5	20
1991	W1YG	p-p 45s	5	40
1992	K2OA	10	5	28
1993	W3INV	10	3	15
1994	K3DZ	Hartley	2	29

Table 1. Representative scores of some stations running less than ten watts input.

Some constructors provide an insulated shaft extension or, better yet, a grounded metal panel. These precautions were not common in the early rigs and often led to considerable frustration and, not infrequently, out-of-band operation. In those days, no one knew what his exact frequency was - he simply tried to stay inside the band. When he called CQ, he tuned the whole band looking for a reply. The ARRL suggested that hams make use of QLH (tuning low to high) or QHL but few followed this procedure.

The Colpitts oscillator, Figure 1-B, eliminates the problem of the 'hot' rotor but introduces a new problem. There are now two tuning condensers and the ratio of their capacitances determines the excitation level. Thus they should be ganged. You may recall that nearly all grid-dippers employ the Colpitts circuit and use a split-stator tuning condenser. The frequency band used in the AWA contest (3580-3600 kHz) is so narrow that it would suffice to vary just one of the condensers. Thus the Colpitts really should find wider acceptance in the 1929 QSO Party.

A few hams use the TPTG oscillator, Figure 1-C. Feedback is by means of the grid-plate capacitance of the tube. You tune the plate for minimum Ip and then tune the grid for the desired frequency. The advantage of the TPTG is that the rotors of both tuning condensers are at ground RF potential. The TNT, Figure 1-D, is similar but omits the grid tuning condenser. Instead, the grid coil has more turns and is broadly self-resonant at the desired frequency. The TNT is well named - in the hands of a novice, it is very tricky and difficult to tame. It is infamous for its atrocious note and tendency to drift.

The circuit is deceptively simple and therefore attractive to the beginner. My advice is to shun it unless you are an electronics expert or really do desire a 1925-ish signal. In the old days, a ham might report that "ur sigs pdc" where pdc meant 'pure direct current'. But, with a TNT, it well might mean "pigs devouring corn!" Even so, you will hear a few stations using TNT rigs - they add an unmistakable old-time flavor to the 1929 QSO Party.

All self-excited oscillators should be

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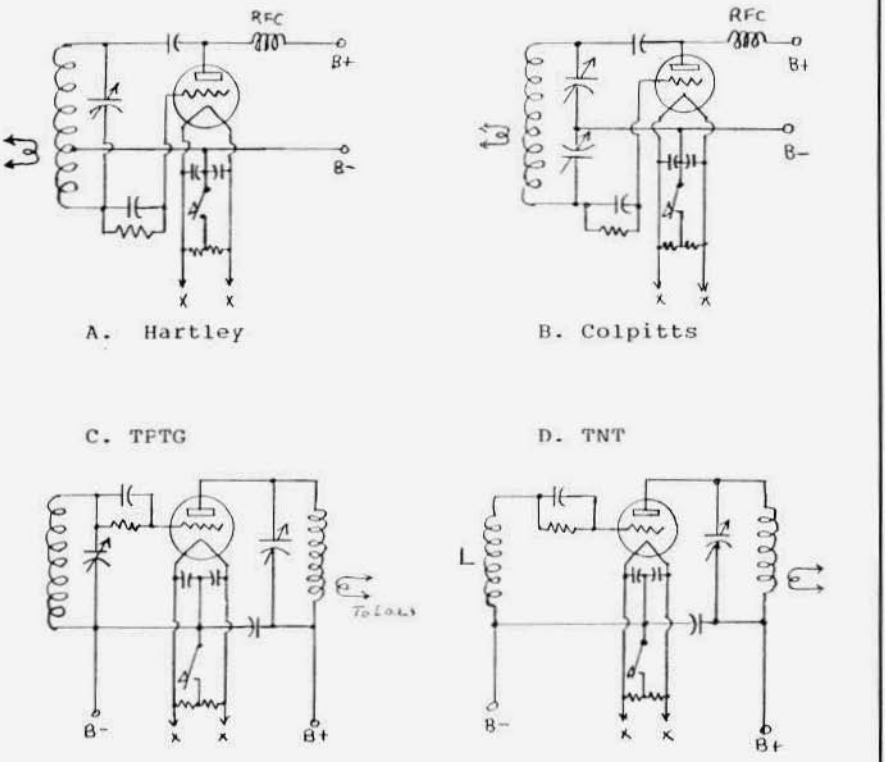

Fig. 1. Basic self-excited oscillators.

powered by a well-regulated and well-filtered power supply; otherwise, the signal will exhibit chirp and a buzzing sound due to AM and FM modulation. You will hear a lot of this during the AWA 1929 QSO Party. Not a few of these stations will receive OO notices. I received one in the 1984 spring contest for chirp. I quickly modified my transmitter to eliminate the chirp - see ER #74, June 1995, A "1937" Transmitter.

One of the highlights of any AWA contest is working W2AN - the AWA's headquarters station in Holcum, NY. Bruce Kelley is the chief operator. During the spring contest, he uses an 807 rig with primary keying that results in a beautiful bell-like tone. You will also be very pleased when you receive the distinctive and unique QSL card from 2AN.

Old Time Tubes

Most contestants use the 210 tube which RCA introduced in 1925 as a new, powerful audio output tube. But '10s are getting scarce and if you find one it will probably cost anywhere from $15 to $25. Even the wartime version (VT-25) is hard to find.

Next best choice is the '45 which came out in 1929. But these also are very scarce and expensive. Some fellows have

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WH9-61	7-1836	Adapter Cable
WH11-51	7-1836	Adapter Cable
WH-17	5-2195	Floppy Disk
WH-27	5-2167	Floppy Disk

The Heathkit Manual Cross-Reference List, Educational Products:

Model	Manual	Equipment
EB-1010	7-2023	Electronics Dictionary
EE-3105	5-2230	Oscilloscope course
EI-3133	5-1884	Soldering course
EK-1	5-253	Basic Electricity course
EK-2B	5-352	Basic Radio course, Part 2
ER-3701	5-2008	Amateur Radio Novice Lic. course
ER-3702	5-2249	Amateur Radio General Lic. course
ES-600	5-150	Function Generator
EUW-17	5-660	Transistorized Power Supply

The Heathkit Manual Cross-Reference List, Miscellaneous Products:

Model	Manual	Equipment
CS-2048	5-2181	Speed Control
GB-1201	5-1820	Digital Stopwatch
GB-1201E	5-1820	Digital Stopwatch
GC-1195	5-1886	Digital Floor Clock
GC-1197	5-1886	Bookcase Clock
GCA-1195	5-1896	Clock Chimes
GD-51A	5-728	Wireless Intercom
GD-160	5-1297	Intercom
GD-1187	5-1903	Touch Switch
GD-1246A	5-2364	Rechargeable Light
GD-1287	5-2067	Touch Switch
GD-1297	5-2458	Air Cleaner
GD-1776	5-1971	Heating Control
GD-3510	5-2453	Lighting Control
GDA-19-4	5-1230	Digital Servo
GDA-20-1	5-427	Garage Door Opener
GDA-47-4	5-954	Digital 5 Proportional Servo
GDA-1380-1	5-2007	Target Accessory
GP-1044	5-1585	Battery Charger
GTA-18-2	5-1097	Light & Horn Kit
GTA-101-2	5-1328	Lighting Kit
GU-1820	5-2571	AC Power System
ID-1290	5-1544	Weather Station
MI-1031	5-1439	Depth Sounder
MI-2900	5-1456	Fish Spotter
MI-2901	5-1457	Fish Spotter
MI-2916	5-2332	Depth Sounder
MI-2917	5-2333	Remote Readout
PT-1500	5-2236	Darkroom Timer
PTA-1500-2	7-1855	Dual Foot Switch

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used the 201A, 71A, and even older receiving tubes. A few people have used 100 watt transmitting tubes such as the UV203 and the WE-211D. But all these tubes are rare and expensive. While pondering this situation, it occurred to me that there is a low-power triode that is widely available at reasonable cost and that everyone has overlooked until now. I refer to the type 27, which RCA introduced in 1927. All the published data shows the tube used as a detector or class A audio amplifier so there was a question - how would it stand up in a ham transmitter? I built a breadboard Hartley oscillator and discovered that here was the answer for anyone wanting to get into the AWA 1929 QSO Party at low cost!

Part 2 of this article will give complete details on a simple 1-tube '27 Hartley oscillator that puts out 3 watts and which I used in the most recent 1929 QSO Party to work 27 stations. ER

NOTE: If you want to join AWA, write to Joyce Peckham, Box E, Breesport, NY 14816. Dues are $15 per year.

To join AMI send $2 to:
AMI
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Part 2. The Transmitter and Power Supply

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Synopsis

Part 1 of this article told about the AWA's 1929 QSO Party, its rules, the types of self-excited oscillators employed and the results you can expect if you enter this exciting and fun-filled contest. What follows is a description of the 1927 Hartley oscillator I used in last November's 1929 QSO Party.

The '27 is a 1927 Tube

In 1984 I built a Hartley oscillator using a type 10 tube. It worked well and was used in nine of the AWA contests. In October 1985, I began to think about building a new rig which might induce some of the ER gang to get into the AWA's 1929 QSO Party. After several false starts, I hit on the idea of using a type 27 tube. It is a 1927 tube, widely available at low cost. But would it be able to handle the job? A breadboard version quickly proved that it would indeed do a fine job.

The '27 Hartley

The complete circuit of the '27 Hartley transmitter is shown in Figure 1. In the standard Hartley circuit, the filament (or cathode) is at ground RF potential making it necessary to insulate the rotor of the tuning condenser. But here I have shifted the ground connection so that the rotors of the tuning condensers (C1, C2, C3) can be grounded directly to the chassis. This required the addition of RFC1. I used a 50 uH choke that was in my junkbox. This choke must be able to carry the 1.75 amp filament current without dropping the filament voltage more than about 0.1 volt. A good choice is the Miller No. 5248 hash choke (68 uH, .054 ohms) available from Mouser Electronics as their 542-5248.

I chose the tank circuit constants so that the dial would read directly in kHz. The Kurz Kasch dial reads 0-100 and this corresponds to 3500-3600 kHz. The Hammarlund band-spread tuning condenser, C2, has a capacitance range of 5-20 pF. This then calls for an inductance of 7.55 uH - see ER #65, Sept. 1994, pg. 29, for the formula. My junk box provided an old B&W 40 JEL 75-watt transmitting coil. The base and link were discarded. When cut down to 15-1/4 turns, this coil measured 7.55 uH. Coil L1 is mounted on a lucite plate as shown in Figure 2. A 3-1/2 turn link, L2, is arranged so that a 180° turn of the 'LOAD' control knob varies the coupling from zero to maximum. Band-set condenser C1 is set once and can then be forgotten. At first, I put a shaft lock on C1 but tightening it produced a small change in frequency so the locking device was removed. A small condenser, C3, permits quick and easy recalibration if this becomes necessary due to changes in antenna loading.

The adjustable link, L2, is shown in Figure 2. The end of the fiber shaft, to which the link coil assembly is attached, is cut at a 45° angle. Thus a 180° rotation of the shaft varies coupling from zero to maximum. If this is a little difficult to visualize, cut the end of a short piece of 1/4" dowel rod at 45° and glue a 1-1/4" disc of paper to this angled end. Hold this above Figure 2 and observe what happens as you rotate the shaft.

Front view of the '27 Hartley

The loading coil shaft is supported by a bracket on which a piece of spring wire provides friction to hold the proper adjustment when found. Not shown on Figure 2 is the panel bearing through which the shaft passes, two washers placed on the shaft between the bearing and the LOAD knob and a hub or collar with setscrew next to the back side of the panel bearing. These serve to prevent axial movement of the shaft. The output leads connecting to L2 are made from an old Radio Shack clip lead consisting of eight strands of untinned No. 37 wire, equivalent to No. 28 but much more flexible.

Normally, the loading is set to give three-watt output as indicated on the SWR/PWR meter in my Kenwood AT-200 antenna tuner. Once this setting is found, it needs no further adjustment. Thus, if the builder desires, he could use a simpler coupling system. For example, the coupling link could be made of stiff wire which, when correctly positioned, will remain in the desired position. NOTE: A change in loading will usually affect the frequency so final adjustment of C1 should be made after the desired loading is obtained.

Spotting

Spotting is controlled by switch S1. Section A connects the oscillator to a 50 ohm dummy load, section B turns on the power supply and section C reduces the power to make exact zero beating easier. As shown in Figure 1, it is still necessary to depress the key to turn the oscillator on. Alternatively, one could use a 4 pole-2 position switch at S1 with section D used to short the key jack, J1.

If your antenna coupler is properly adjusted (SWR=1) so that the Hartley oscillator 'sees' a true resistive 50-ohm load, then the zeroed frequency will be very nearly equal to the SEND fre-

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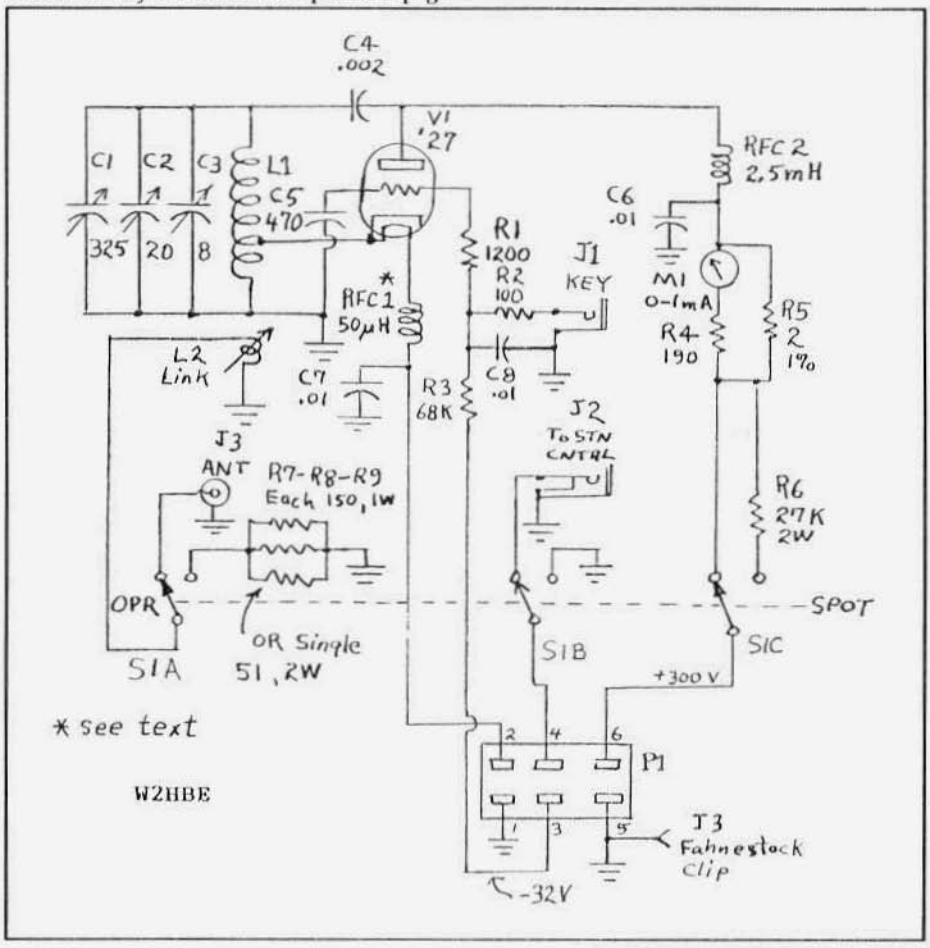

Figure 1. Wiring diagram of the 1927 Hartley oscillator.

quency. If you don't achieve such a match, these frequencies could be several kHz apart. Another point to keep in mind is that lowering the plate voltage by means of R6 can also affect the 'zero' frequency so be sure to check this out.

Since C1 is rather large, it is difficult to set it precisely at the right value; e.g., to make 3585 kHz occur exactly at 85 on the dial. This is where C3 comes in handy. It eases the final, exact calibration. Now, if you hear a CQ (actually he will be sending CQ AWA or simply 'AWA') at 3589 kHz, you can quickly set your Hartley to this frequency (dial at 89) thus increasing the likelihood of his hearing you.

Power Supply

Almost any power supply that will give about 300 volts will suffice. In addition, you will need 30 to 45 volts bias if you use blocked-grid keying and, of course, 2.5 volts for the filament of the '27 tube. A schematic of my power supply is shown in Figure 3. To reduce the possibility of keying chirps, the power supply should have good voltage regulation. For this reason, I used silicon diodes rather than a vacuum tube rectifier. A type 80 would be a good 1927 tube but it would waste power and impair regulation. An oversize choke at L1 and a 15K bleeder, R1, also help to

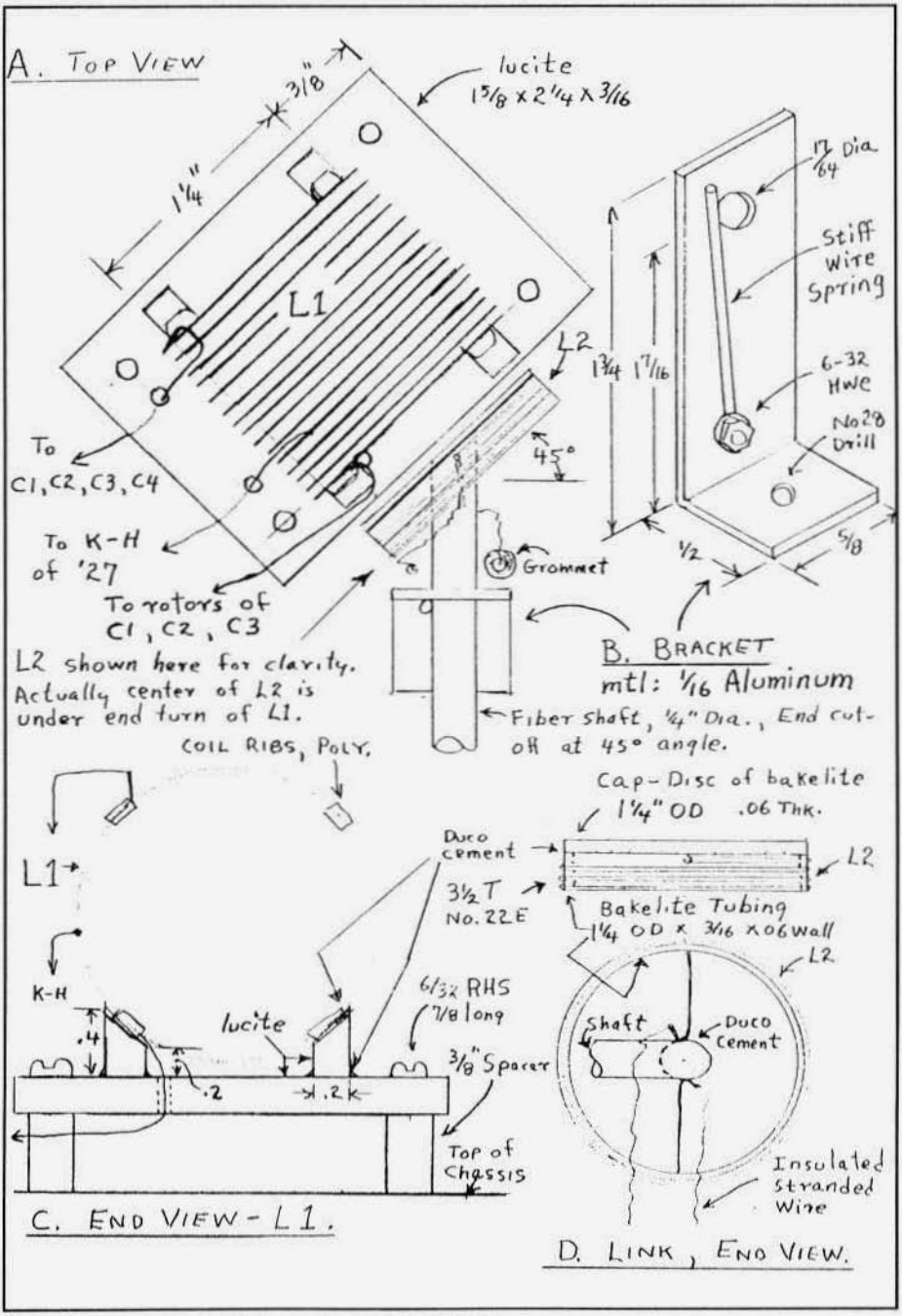

Figure 2. Details of coil L2 and variable link L2.

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Rear view of the '27 Hartley

improve regulation. With the filtering provided by L1-C1, most signal reports have been T7. Remember, in this contest, a T9 signal marks you as a sissy!

The unused 5V and 6.3V windings are connected in series-aiding and applied to a voltage doubler to secure the blocking bias of approximately -33 volts.

Switch S3, labeled REMOTE CONTROL, allows the B+ to be turned on by a remote SEND-RECEIVE switch. At my station, this switch also turns on the receiver B+ ON or OFF and connects the antenna to either the receiver or the transmitter. Note that the switch S1-B on the Hartley can turn on the power supply B+ in SPOT mode even when the Station Control switch is in the receive position.

The power supply was built on a 5x7x3 aluminum chassis. Parts used in the bias rectifier were mounted on a piece of perfboard. Two nylon tip jacks are provided to allow checking the B+ and bias voltages. Switch S3 and Jack J1 are located on the rear chassis apron.

Operation and Results

I increase loading until plate current is about 31 mA. At this load, the power supply voltage drops to 290 volts (300 volts at no load) so power input is about nine watts. Power output is 3 watts. Efficiency is 33%, which could be improved a little bit by using a higher Q tank.

In the 1995 QSO Party, I worked 27 stations in 11 states including IN, OH, MA, NC and GA. Propagation and radio conditions were bad but even so I received good RST reports most of the

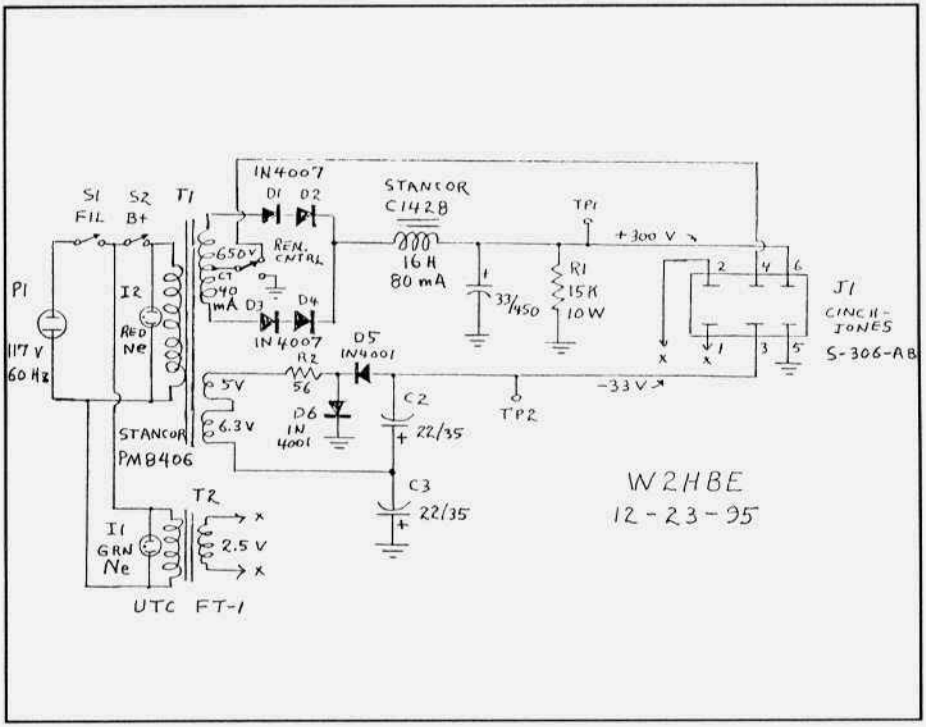

Figure 3. Power supply used with the '27 Hartley oscillator.

time. What it boils down to is this, you can work a lot of stations in this contest, even with low power, because all the other contestants want to work you - they want the points!

So if you want to see what great fun the old timers enjoyed, build a self-excited oscillator and join AWA. I hope to work you in the next AWA contest! ER

NOTE: If you want to join AWA, write to Joyce Peckham, Box E, Breesport, NY 14816. Dues are $15 per year.

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